

# Mission and Test Capabilities



## About Arnold

Arnold Air Force Base is not a typical military installation.

The base is almost 40,000 acres, with a 4,000-acre lake. Military family housing has only 39 units for married accompanied military personnel. It hosts no flying units, and the number of assigned military personnel and government civilian employees is about 10 percent of the base's work force.

Arnold AFB is also the only active-duty Air Force base in Tennessee.

The base is the largest employer in the local area and has an annual economic impact of more than \$400 million on the Middle Tennessee economy.

## Arnold Engineering Development Center

The host unit at Arnold AFB is the Arnold Engineering Development Center. AEDC is the world's most diverse complex of aerospace flight simulation test facilities.

AEDC is an Air Force Materiel Command test and evaluation center and is the Air Force and Department of Defense's ground flight simulation center.

The center operates 58 test facilities at Arnold AFB and AEDC White Oak, Md. (Hypervelocity Tunnel 9).

Both the base and the center are named after World War II commander of the U.S. Army Air Forces, 5-star General of the Air Force Henry "Hap" Arnold.

AEDC engineers, scientists, technicians, craftsman and support personnel have been involved in the development of nearly all U.S. military and NASA high-performance aircraft, missiles and space systems including all manned space systems from Project Mercury to the Space Shuttle.

The center's test facilities include jet and rocket engine propulsion test cells, aerodynamic and propulsion wind tunnels, space chambers, arc heaters and ballistic ranges that can simulate virtually every aspect of flight from ground level to deep space. Ground testing before flight reduces risks, saves lives, equipment and money in operational testing.

## Outsourced workforce

The center's Air Force and Navy staff provides management direction, resource allocation, oversight and contract administration.

The majority of the work is performed by two support contractors – ACS, a joint venture of Computer Sciences Corp., DynCorp and General Physics; and Sverdrup Technology, Inc./AEDC Group.

ACS is responsible for center support including civil engineering, environmental services, information systems, security, fire protection, purchasing, custodial, food services and public affairs.

Sverdrup's responsibilities include conducting propulsion, space and flight dynamics testing.

AEDC has had a contractor work force since it opened in 1951. Today the center is held up as a model for DoD outsourcing.

Approximately 300 Air Force and Navy military and civilian personnel are assigned to AEDC. The total work force of the center is around 2,900. The median age of the work force is 46, with an average of 16 years of center experience.

## AEDC Testing

AEDC supports the development of aerospace systems through its major testing facilities broken into three business areas: aerodynamics, aeropropulsion and space and missiles.

## Aerodynamics

The majority of the aerodynamic testing is done in the two large wind tunnels in the Propulsion Wind Tunnel facility.

The facility has two 16-foot wind tunnels, one supersonic and one transonic. Transonic refers to speeds just below and just above the speed of sound. The tun-



nels are used primarily to test the aerodynamic performance of large models of aircraft, spacecraft, rockets or full-scale smaller sized missiles like the Navy Tomahawk missile.

During wind tunnel tests, conditioned air is blown past a stationary model and flight characteristics are measured. In some cases, the propulsion systems and inlets are tested simultaneously to make sure they are designed to provide adequate airflow to the engine under all flight conditions.

A four-foot transonic wind tunnel is used for compatibility and separation testing. Store separation investigations make sure bombs, missiles, fuel tanks or other externally-carried stores separate cleanly from the aircraft when released.

Three hypersonic wind tunnels in the von Karman Gas Dynamics Facility also are operated under the Aerodynamics business area

Test and evaluation tools include not only wind tunnels, but also computational modeling, including Computational Fluid Dynamics.

Flight testing is risky and costly. To mitigate these risks, AEDC is increasing the use of Integrated Test and Evaluation. An integrated, knowledge-based approach to development, test and evaluation reduces cost by increasing computer modeling and wind tunnel simulation accuracy and fidelity, reducing the number and duration of individual flight tests required and reducing flight test costs.

## Aeropropulsion

The Engine Test Facility's engine test cells are used for the development and evaluation testing of propulsion systems for high performance aircraft.

Ground testing of these air-breathing engines provides test data evaluating the performance, operability and reliability of the engine. It can help cut development time and the number of test flights required for a manned aircraft or unmanned weapon system.

ETF's Aeropropulsion Systems Test Facility with two test cells provides engine testing from takeoff, through climb to altitude and multi-speed combat ma-

neuvers, to descent and landing. ASTF is designed for full-mission simulation of advanced jet engines.

ASTF has tested large commercial jet engines like Pratt & Whitney's 4000 series and Rolls-Royce's Trent 800, both used on the Boeing 777. High performance military jet engines like the Pratt & Whitney F119 for the new Air Force F-22 Raptor and the multi-service, multi-national Joint Strike Fighter are under development in these test cells.

## Space & Missiles Systems

The Space & Missiles Systems Division operates hypersonic wind tunnels, rocket test cells, space environmental chambers, arc heaters, ballistic ranges and other specialized test units. These test facilities can simulate flight conditions from sea level to altitudes of 300 miles and velocities from subsonic to well above Mach 20.

Large Rocket Test Cell J-4 is the largest simulated altitude liquid rocket engine test cell in the world. It tests liquid fueled rocket engines under near space conditions. The upper stage motor for the Apollo moon program's Saturn V launch vehicle was tested here as well as upper stage engines for Titan and the Air Force's new family of heavy lift Evolved Expendable Launch Vehicles.

Large Rocket Test Cell J-6 is the largest simulated altitude solid rocket motor test facility in the world, capable of firing solid rocket motors of up to 500,000 pounds thrust at simulated altitudes of 100,000 feet. Minuteman and Peacekeeper Intercontinental Ballistic Missile upper stage motors are test fired in this test cell.

Rocket propulsion systems are tested to measure thrust, propellant burning, nozzle control, shutdown characteristics and ignition.





Hypervelocity testing in controlled weather simulations such as snow, rain or dust can be tested in the hyperballistic ranges. The effects of erosion, vibration and temperature also can be tested.

These ranges are used to study the impact of natural or man-made debris on aircraft, space vehicles and satellites.

A bird impact range is used to study the effects of bird strikes during flight on aircraft canopies and wing leading edges.

Four high-vacuum space chambers simulate the vacuum of space and solar radiation that vehicles experience in actual flight.

The large Mark I space chamber, which can simulate altitude of up to 300 miles, tests military and commercial satellites. The NAVSTAR Global Positioning Satellite was tested in this facility. Loral Space Systems is scheduled to test 3-4 commercial satellites a year starting in fiscal year 2000.

The DECADE Radiation Test Facility is a new advanced generation nuclear test facility designed to test 21<sup>st</sup> century space and missile systems and their components against nuclear weapons' X-ray effects.

The Advanced Missile Signature Center supports the Ballistic Missile Defense Organization with data archival, analysis and experiment support activities.

## Technology

The Applied Technology Directorate provides technologically advanced tools and services, such as new facility test techniques, computational modeling,

simulation and analysis, instrumentation, diagnostics, information technology and foreign technology assessment to support AEDC's developmental test and evaluation facilities and customers.

## Test Support

AEDC provides a full spectrum of support for its test facilities including planning and developing test equipment and procedures. Capabilities include repairing, building, maintaining and installing test equipment.

Laboratory services ensure reliability and accuracy of materials, instruments, equipment and test articles.

AEDC maintains the DoD's ninth most powerful computer capability, and is ranked in the Top 100 high-performance computing sites worldwide. The center's mission requires reliable, time-critical secure processing of test information in near real-time with high-performance computing systems connected to test facility networks.

The high-performance computing center supports a wide variety of testing across the center, including support for operational systems and new systems such as the F/A-18 Super Hornet, the F-22 Raptor and the Joint Strike Fighter.

## Environment

AEDC emphasizes environmental stewardship as a part of everyone's day-to-day commitment. Environmental concern is a natural consequence of chemical use in important test operations accomplished at the center. The environmental management division manages conservation, pollution prevention, restoration and compliance.

AEDC uses large amounts of fuels, oils, hydraulic fluids, refrigerants, antifreeze, solvents, acids and other such materials to accomplish its test mission. The center seeks to eliminate or replace hazardous materials with environmentally friendly ones.

